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Arrangement For Inspecting Objects, Especially Masks In
Microlithography

In order to observe objects or images of objects disposed in vacuum chambers, it is necessary to either insert the observation lens and the sensor (camera) into the vacuum chamber or to observe the objects or images through a vacuum window.

This is particularly required in case of images using extreme ultraviolet radiation (EUV) if this radiation is converted using scintillators into radiation of a different wavelength and then reproduced on the sensor using additional optics (US 5498923).

If the sensor is disposed in the interior of the vacuum chamber, this leads to gas emission of e.g. siloxanes or hydrocarbons from the sensor. This poses a high hazard of contamination of the devices disposed in the vacuum chamber. Optical elements that are exposed to radiation that is rich in energy, particularly EUV radiation, are especially at risk.

If the sensor is disposed outside this vacuum chamber, the radiation used for the image must be guided through a vacuum window onto the sensor. As a result of the window in this case, limitations arise with respect to the quality of the optical images and the usable aperture of the imaging optics.

Inventive solution:

This problem is solved according to the present invention, in that the scintillator itself forms the window or configures the imaging optics disposed in front of the sensor in such a manner that the imaging optics or a part of them forms the vacuum window.

Different configurations are possible depending on the respective tasks.

a) The imaging lens is vacuum-tight and forms the actual window.

b) The scintillator forms the vacuum window.

The vacuum window can be designed advantageously such that it can be replaced, if the scintillator starts to age.

c) A part of the lens forms the vacuum window.

Here, it is particularly advantageous to configure the first lens of the imaging optics from the source of radiation as the vacuum window because then the remaining parts of the lens are not exposed to the vacuum.

Furthermore, the first lens can be permanently arranged in the vacuum chamber and the remainder of the lens can be interchangeable in order to change the imaging conditions, for example for recording an overview image by adding other lens groups.

Using all the specified options, it is possible to arrange the actual sensor that represents a high risk of emissions and

contamination outside the vacuum chamber and yet achieve a superior optical imaging quality.

The present invention is explained more elaborately on the basis of figure 1.

The object field OF illuminated using an EUV source of light LQ via illuminating optics EUVB0 is reproduced on a scintillator S by means of EUV optics EUVO. The scintillator converts the image of the EUV wavelength range into an image of a long-wave range, which is then reproduced on the sensor using an image lens O (i.e. micro lens). In doing so, the imaging lens/the scintillator is used according to the invention in one of the configurations described above.

The lens O is illustrated schematically. A first optical element can form the window, which is then followed by other lens elements that are arranged outside the vacuum chamber VK and are not illustrated here.

Figure 2 illustrates an optical example for the lens O.

The lens illustrated is advantageously a cement-free hybrid lens as has been described in detail in DE 10130212 A1. Its advantage is the low material expenditure involved and better optical quality. The use of a diffractive element DOE increases refraction and has an achromatising effect.

The first optical element F1/F2 and also e.g. the DOE F9/F10 can be the window of the vacuum chamber here.

Data regarding the hybrid lens (mm)

Surface	Radius	Thickness	Material	
F1	unlimited			
		1.000	Q1 (synthetic quartz)	
F2	Unlimited			
		0.3028	Air	
F3	-2.744			
		2.9773	Bk10	
F4	-3.116			
		0.0200	Air	
F5	-9.911			
		2.5723	Bk7	
F6	-5.292			
		0.0500	Air	
F7	19.699			
		2.9207	Bk7	
F8	-11.828			
		0.0500	Air	
F9	Unlimited			
		2.0033	Bk7	
F10	Unlimited			
F11	23.072			
		2.000	Nsf6	
F12	7.541			
		0.5624	Air	
F13	9.051			
		3.2297	Psk53a	
F14	-15.148			
		15.2701	Air	
F15	-4.369			
		0.500	Ssk2	
F16	-117.556			

... etc. to the tube lens (not illustrated)